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Due to the interlocking nature of a number of projects, this reports contains coding to reflect the funding source: MODIS funded activities are designated with an M, SeaWiFS with an S, and Pathfinder with a P.

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A. NEAR TERM OBJECTIVES

A.1 Automatic Processing Database Objectives (P)

A.1.1 Continue testing of methodology
A.1.2 Explore inclusion of ancillary datasets into Pathfinder processing
A.1.3 Continue to establish the real-time processing stream

A.2 Processing Systems Objectives (M)

A.2.1 Continue the processing of the ocean color data
A.2.2 Continue investigation of sensor and data quality
A.2.3 Continue to develop and expand the processing environment
- a. increase computational efficiency through concurrent operations
- b. determine and apply more efficient methods of data availability for processes

A.3 Matchup Database Objectives (P)

A.3.1 Continue to expand and refine the matchup database as applicable
A.3.2 Continue to establish the real-time matchup database
A.2.3 Continue to develop the ocean color Matchup Database

A.4 DSP Objectives (M)

A.4.1 Continue testing of processing methodology.
A.4.2 Continue to expand the number of sites supported.
A.4.3 Expand the supported hardware/software platforms

A.5 MODIS Objectives (M)

A.5.1 Continue extensive testing using global color and AVHRR GAC data with database processing to establish:
a. algorithm capability
b. machine and operating system stability
c. functionality required for the processing and analysis environment

A.6 Team Interaction Objectives

None listed.

B. OVERVIEW OF PROGRESS FOR 1997

B.1 Automatic Processing Database (P)

B.1.1 Pathfinder processing

B.1.1.1 General

During 1997, The "PFV4" (Pathfinder version 4.0) processing was completed on these time periods and satellites:

week 46 of 1988 to late 94 - NOAA 11
late 94 to week 2 of 1995 - NOAA 9
week 1 to week 52 of 1997 - NOAA 14

Added to the automatic processing procedures was a timing feature, to allow individual computers to be added or removed from the processing stream. This is for machines that are used interactively during the day, but available in the evening and overnight for processing. Several special projects were also produced, including a special low-temperature run (for cloud investigation), several regional extractions over limited time spans, and a large run of scan-segregated files, running from Feb. to July of 91 through 95.

Four years of the Pathfinder PFV4 daily binned files were copied and sent to JPL by the end of the second quarter of 1997.

In June 1997, a special run of the 4km processing stream was made for three weeks in early 1997, using the 1995 coefficients, because none had yet been calculated for the current year.

The new version of the basic Pathfinder processing (version 4.2) was tested in October. The change in the quality flags was tested, and numerous tries were needed to insure that the mask bits and quality flags were were working as intended. Most of the Oct. processing consisted of short runs to test various parts of the PFV42 (Pathfinder version 4.2) processing and the new 3-bit quality.

"Version" processing controls were developed. The ability to output difference bands had existed previously in the programs, but the development in October addressed the ability to

direct and control the calculation type and the variables output during a run. A number of processing paradigms had been used previously (difference processing types, different resolutions, regional processing), but had before been handled as special cases, requiring editing of the automatic processing environment. The addition of the processing "version" finally allows an easy way to choose among the processing paths for a given set of data.

The 4km resolution was finalized in November, and a processing version developed to produce 4km regional files. A "coastal" mask was developed, intended to produce data files at 4km resolution along the world coastlines (out to about 800 km).

Equipment problems limited processing in November, and software problems required re-running much of what had previously been processed. Specifically, PFV42 was processed for 1996, however, an error in the cloud masking method (which was using the new 3-bit quality incorrectly) made the output quality incorrect. A second run of 96 was begun, but slowed by equipment problems during the holidays. Also, an orbit was identified that had anomalies in the sst homogeneity test.

The regular PFV42 was finished for 96 in December. Finally, near the end of the month, a run was started on the scan-segregated data. This run uses the maximum sized output file, and produces seven time the number of files as normal processing, so it proceeds very slowly. The normal PFV42 processing must first be run, to produce the 3-week reference file. This was done for the first scan-segregated test period (9120 to 9139) the the first four weeks of scan segregated files were produced.

At year's end, we have now defined a 4 km product computed within 800 km of the major coastlines. The product volume equals the global 9km fields. Production of the 9 km global and 4 km coastal product will alternate for a given year as we compute backwards in time to produce the complete AVHRR time series using the version 4.2 pathfinder algorithms.

B.1.1.2 Real-time processing

The real time processing was advanced by the development of a daily job that updates a number of files dependent on the current satellite navigation. There are sets of files that specify time parameters needed for the processing, and must be calculated from an orbital model. One set of files lists the beginning and ending of the data-day, and another lists the times of each ascending and descending node for each satellite. Previously, these files were historical in nature (since the processing was itself historical). However, in implementing the real-time processing, it was evident that these files had to be updated daily.

The (orbital) ephemeris data is automatically updated on the Miami system at midnight. The daily update job being developed runs after the daily ephemeris update, and uses the new orbital elements to calculate the ascending/descending nodes and and ascending and descending data-day boundaries for the current AVHRR data. This data must be distributed to a number of directories residing on a number of machines. This daily update job is not complete, and its functions will be expanded.

The use of the automatic processing system to control the real-time processing was begun, and real-time processing jobs were tested. The use of the "version" definition was successful, but many adjustments were needed, and more wail be needed to produce real-time daily files.

It was discovered in October that occasionally the transfer of the GAC orbit data from the VMS receiving computers to the UNIX spooling computer was not successful, but was

not producing an error message. We have addressed the cause of the failures, and we have added more stringent error checking as well.

The real-time processing was more or less finalized by December, but equipment problems still prevented smooth operation of all elements. These problems should be resolved early in the first quarter of 1998.

The key steps in this processing are:

1. The previous days' orbits are transferred to a spooling directory on the computer "orange".

2. This triggers the scanning and job addition to the processing database.

3. Independently of this, an update job is run to use the previous days' orbital ephemeris data to calculate the previous days' ascending and descending nodes, and the time of the beginning and ending of the ascending and descending data-days.

4. The automatic processing controls the processing of the orbits, and the processed files are stored on the SGI machine "andrew".

5. If the real-time processing has been successfully run for three days or more, completion of all orbits for a day triggers the daily global job for the previous day.

6. An independent job checks the number of days that have been stored on "orange", and archives to the DLT tape archive all but the last 5-7 days' worth of orbits.

For the Pathfinder processing, the Reynolds Optimal Interpolation weekly one-degree files are needed for the SST calculation. For the real-time data, the required week does not yet exist, so the procedures were modified to permit use of either the previous week, or the next previous week files. In addition, "formal" coefficients have not yet been constructed, so the coefficients from the previous year are currently being used.

It was decided to reprocess the real-time days as soon as the Reynolds OI file becomes available, so two real time processing streams have been defined: (1) the rt0 version is immediately performed on orbits, using the previous years' coefficients and the OI weekly file from 1-2 weeks before, and (2) the rt1 version which will still use "incorrect" coefficients, but will use the correct weekly file. The pfrt0 files will only be kept until the the pfrt (rt1) are made. These will be the final "real-time" files, to be kept until the true Pathfinder coefficients can be calculated.

B.1.2 Automatic Processing Development

Many adjustments were made to the processing procedures, to streamline them and make the process more efficient. A timing feature was added to the automatic processing procedures to allow individual computers to be added or removed from the processing stream (this permits proper utilization of machines that are used interactively during the day but which are available in the evening and overnight for processing).

The entire Pathfinder/autosys processing system was modified to permit the definition of two or more separate processing streams that can run independently, but concurrently. Job names are now prefaced by a version type (a two-character code giving the type of processing) and each processing stream defines its own run parameters (such as resolution, type of output file).

A new method of making the archive tapes for transferring the PFV4 files to JPL was not successful, so we returned to cloning of the archive tapes. The cloning of all archive tapes for JPL was completed.

A number of minor problems were discovered and corrected in the the PATHTIME program (which combines two or more binned data files).

Processing procedures were adjusted to have the SGI machine, "andrew", perform the daily and weekly jobs, formerly done by the DEC machine "apricot". In addition, the spooling job (entry point for the input data files) where changed to run on "apricot".

Procedures were developed and archive methods tested to produce global 9 km maps from the binned data. A daemon was written to run these procedures that retrieve the 9km daily binned files from the DLT tape archive one week at a time and make the 9km global maps as well as any other products that be needed. Remap characteristics for several regional products were developed. The binned files currently contain both the interpolated Reynolds input values (bsst) and the Channel 4/5 difference (ch4m5); a program was written to permit these data bands to be stripped from the binned file if so desired.

An 11-year weekly climatology of the PFV4 data set was produced. A daemon was developed to retrieve a single week for each year from the DLT library and calculate the 11-year-mean. Upon its completion, the 11-year weekly climatology was compared to the climatology calculated from Arthur Mariano's objective analysis of the 18km 2-day field. A special run was made to compare two ways to calculate SST: the most current Pathfinder method, and Arthur Mariano's algorithms. Two weeks in each season of 1991 were calculated using the scan-segregated method (which separates data based on the scan angle of the AVHRR sensor). Maps of this Mariano/Pathfinder run were made and the binned data were archived on the DLT.

The calculations of tau-1 (which has occasionally been used as a diagnostic filed) were found to contain errors and were subsequently corrected.

A corrupted weekly file was identified in week 9224, and it was discovered that a number of files in the DLT archive had not backed up correctly (a series of zero-length files, 8744 to 8751, were encountered on the DLT, and they required recalculation). The corrupted files were replaced.

It was discovered that the most recent tree method of pixel selection was not used for the PFV4 (Pathfinder 4.0) version. Some other changes were also made, and the entire set was recalculated. Since these additional changes were not major, this run was termed PFV41 (Pathfinder version 4.1). Omission of the flag test primarily affected how each pixel was flagged, and not the value of the SST calculation itself. After the completion of PVFV41, it was decided to make changes to the mask bits in the Pathfinder processing. This change was completed by November. This product will be termed PFV42 (Pathfinder version 4.2).

Procedures were implemented to extract the processed data that corresponded to the points contained in the Matchup Database.

Modifications to processing were made to produce 4km binned data in addition to the normal 9km bins. Adjustments to the processing had to be made to accommodate the 4km product production. The program that bins the scan data is highly memory-intensive, and the version that is large enough for an orbit piece at 4km can only run on our two biggest machines. As expected, these runs are considerably slower than the normal 9km processing stream. However, this capability is now fully functional.

A coastal mask was developed to be used to denote areas where 4km processing will be desired. This mask covers approximately 800 km offshore of most coastlines, and is intended for use in studies of boundary currents.

IR algorithm test for functional relation of SST retrieval equation coefficients as 10um-11um channel difference and satellite zenith angle.

Using AVHRR brightness temperatures and the Reynold's OI analyzed sst, a series of tables will be generated to test non-linear behavior of coefficients for increments of latitude and time. An initial test will be run using the matchup database. This test will be based on calculation of (Tsurf-T11)/(T11-T12) and (Tsurf-T3.7)/(t3.7-T11) for cloud free pixels from night time observations. The table will be populated as a function of channel difference vs. satellite zenith angle (+/- angles recorded separately to check for effects of stray light). The final tables will be assembled in increments of 10 degrees of latitude and quarterly in time (1 or 2 weeks of observations). We will test a 3.7 and 11 um SST product using emissivity corrected brightness temperatures in place of a scan angle term. Initial tests suggest that a non-linear correction is necessary. We will create programs to test using AVHRR images in conjunction with a similar test using the SST matchup data base.

We began preparations for the analysis of sst anomalies (defined as Pathfinder SST minus Reynold's OI SST) for correlations with other fields, such as SSM/I water vapor and TOMS aerosols (from J. Herman).

B.2 Processing Systems Status (M)

B.2.1 MODIS

B.2.1.1 MODIS Version 1

An addendum to the Version 1 science software delivery supporting production of level 3 declouded products was submitted to SDST on 1/23. This delivery included programs mfill (PGE50) and mcloud (PGE53)and associated scripts, PCF, MCF and test data files.

Version 1 science data processing software was delivered to SDST on 12/4. This delivery supports production of SST and ocean color level 2 products and raw (not declouded) level 3 daily composites. The following programs were included in this delivery: modcol, modsst, mtbin, msbin. Major new features included in this delivery are support for ECS metadata and L3 file formats which do not use HDF external data files (since HDF external files will not be supported by the Rel B ECS data server).

Version 1 build procedures will be used without modification in Version 2.

B.2.1.2 MODIS Version 2 (at-launch algorithms)

We developed programs and procedures to support automated processing of synthetic MODIS data from level 1 to level 2. These procedures manage the staging of synthetic level 1 data and ancillary data, the creation of PCF and MCF files, and the execution of the MODIS programs.

Meaningful testing of level 3 processing will require at least several days of data. We are currently generating one week of synthetic MODIS data for this purpose. The resources required to generate and archive this dataset are significant, and it will not be available until after the scheduled delivery of the level 3 PGES. We will begin stress testing of level 3 PGES after the scheduled January 1998 code submission and provide updates as necessary.

Current versions of PGE09 (modcol) and PGE10 (modsst) PGE20 (mtbin) were submitted to SDST ond Dec 1st for acceptance testing. This delivery contained performance enhancements and modifications required to bring the code into compliance with SDST standards.

B.2.1.2.1 Metadata

MODIS Version 2 Science Computing Facility Software Delivery Guide (2/28/97) was reviewed and comments submitted to SDST.

A list of proposed PSAs, product specific additional searchable metadata, for each ocean data product was submitted to SDST after review of the requirements outlined at the Version 2 Metadata Workshop. Metadata impacts wide range of areas from the external view of the data products to production rules, QA and version control. There are over 250 metadata parameters already defined by ECS and the exact intended usage of each initially was not clear. Moreover, MODIS Ocean processing will require additional searchable metadata to support data processing. An outline of this requirement was requested and delivered to SDST prior to the April Version 2 Metadata Workshop.

MODIS V2 software has been updated to populate the currently proposed metadata.

Current versions of PGE09 (modcol) and PGE10 (modsst) were delivered to SDST on Aug 1th. SDST updated the code with V2 L1 I/O routines and metadata functions. These updates were merged into the current baseline.

B.2.1.2.2 Product File Specifications (EOS-HDF file format)

Revised V2 product file specifications (HDF structure, content, size) were submitted to SDST in May. Due to the limitations of HDF and the lack of support in ECS for HDF external data elements the ocean level 3 products have one parameter per file.

B.2.1.2.3 PGEs/ESDTs

Production rules for level 3 products binned by data-day were discussed at length with SDST and ECS. The implementation was described to us as the following: all L3 products will have PSAs for StartDataDay and EndDataDay (the same value for daily products). An "advanced temporal rule" will be used to ingest these products as inputs. A nominal processing period can be specified which is equivalent to the range of StartDataDay to EndDataDay for the output product; and the "advanced" rule will specify that inputs within the time range are included for some delta before and after the nominal period. This delta will be large enough to include all inputs within the desired StartDataDay to EndDataDay range (some of which will have start/end times outside the "nominal" range). The

StartDataDay and EndDataDay will be run-time parameters set by the production system and written into the PCF files dynamically.

Due to the restructuring of Level 3 files, the number of ESDTs required for Oceans processing increased dramatically. A meeting attended by SDST, Hughes and Miami representatives was held at SDST in February to discuss options for reducing the number of MODIS ocean ESDTs. Three alternatives were presented: (1) Multi-type granules, (2) a production rule which allows input specifications using metadata, and (3) one ESDT per parameter per level. Hughes has recommended using the last option: one ESDT per parameter.

B.2.1.2.4 Build Procedures

MODIS make procedures were updated to conform to the latest naming conventions for directories and build procedure environment variables requested by the DAAC.

B.2.2 SeaWiFS

We began preparations for actual SeaWiFS data processing early in 1997. The automated processing programs and procedures were enhanced to improve resource allocation and monitoring among multiple job streams (avhrr, SeaWiFS, etc.). We developed programs and procedures to support automated processing of SeaWiFS data from level 1 to level 2. These procedures manage the transfer and archiving of files from the DAAC, staging of data and ancillary data and the execution of the SeaWiFS programs.

We received the first SeaWiFS images in the last quarter of 1997, We then began tests of water-leaving radiance (Lw) vs. satellite zenith angle, cloud effects, and calibration using SeaWiFS/anly. Actual SeaWiFS data also now affords the opportunity to test MODIS processing using real ocean color data.

We prepared figures to use for a resources meeting, provided figures for L2 product flow and bubble charts for ocean's L2 and L3 PGE interaction for ocean color and SST. We decided to use same format ESDT for L2 data whether file is for 1 or 2 km resolution. We will flag and only write every other pixel and line for a x2 resolution product.

Checks were run by Ed Kearns to check SeaWiFS retrievals for satellite zenith angle modulation. We assembled of normalized water-leaving radiance (nLw) fields for constant/low chlorophyll fields and tested for variation as a function of satellite zenith angle. These effects have been independently noticed by the SeaWiFS cal/val group.

We received new, provisional SeaWiFS calibration coefficients, and ran selected SeaWiFS days to compare original and provisional coefficients; satellite zenith angle and per band Lw dependencies improved. It was found that values of Lw now correspond more closely to clear water values in open ocean. Our new (old) calibration tests reasonably match the SeaWiFS cal/val team tests.

Jim Brown has ported the MODIS color atmospheric correction algorithm (MODCOL) back to the SeaWiFS program to provide real timing estimates and to validate the algorithm against the SeaWiFS algorithm. Timing runs show the MODIS and SeaWiFS algorithms have comparable run times even though the MODIS algorithm contains numerous enhancements (e.g. vector vs. scalar Rayleigh, quartic vs. second order coefficients, iterative vs. direct coefficient solver). The previously instituted changes for computational efficiency have had the desired results.

B.2.3 Systems/COTS

We continue to work with vendors to try and obtain newest versions of these systems that are compatible with SGI IRIX Version 6.4.

In November we hosted a visit by B. Serafino and R. Buzby of the UCAR/NCAR supercomputing facility. We shared experiences of using DEC and SGI multi-processor machines as alternatives to traditional supercomputers. They offered their experiences concerning SGI and HP. They scale the SGI Origin at approximately 80 mflops, less than the figures used by EOS.

B.2.3.1 Autosys

Earlier in the year, Autosys was installed on the SGI Challenge machine ("andrew") using a temporary license from Platinum.

The permanent licenses for Irix were installed on "andrew" (Challenge, Irix 6.2) and "jaboticaba" (Origin, Irix 6.4). The latest version AutoSys for Irix is V3.2. Autosys V3.2 is not compatible with Irix 6.4 and neither is AutoSys V3.4, so support for AutoSys on Irix 6.4 must wait for the next scheduled maintenance release of V3.4.

Autosys processing has been expanded to include SeaWiFS and MODIS (currently for generating a simulated data set). Adding SeaWiFS together with Pathfinder addresses both the ocean color and SST processing in near real time in addition to the retrospective processing of these data sets.

B.2.3.2 Sybase

Verification and testing of System 11 with the Autosys and the automated processing was completed and our migration to System 11 is complete.

A new 4GB disk dedicated to Sybase was installed on "andrew" and the databases rebuilt on the new device.

A disk crash destroyed the Sybase database on "andrew". We were successful in restoring AutoSys client functions, but until a new disk is located we are without the "andrew" AutoSys console.

B.2.4 ATM Local area networking

We completed Beta testing of ATM for the SGI Origin under IRIX 6.4 and have upgraded to the production release.

We continued the integration of the production ATM network and the new campus ATM backbone with the primary goal to increasing bandwidth through the gateway (ip firewall). The campus ATM switch was connected via multimode fiber (OC3) to the central ATM switch in the remote sensing lab and the firewall machine upgraded with an ATM OC3 adapter. In this configuration, any ATM attached host or network device can be configured to be a part of the campus ELAN (LANE V1.0) or join the Classical IP (RFC1577) subnet used for data processing. This enables the firewall host equipped with dual ATM adapters to have an OC3 connection in both directions. However, the peak data rate we have seen using IP over LANE is 40Mbs vs 80Mbs over Classical IP.

During the last quarter, the production ATM network was upgraded with and additional GIGASwitch/ATM connected to the existing network via an OC12 link. An additional OC12 connection will replace the current OC3 link to the campus switch in the next quarter.

We prepared MOCEAN network requirements for Miami. To send daily full resolution L1 data and 10% of L2, L3 products to Miami will require 12.5 megabits/sec sustained over a 24 hour period. These results were sent to Sol Broder and Wayne Esaias.

B.2.5 Tape library

The DLT tape jukeboxes were upgraded from model TL820 to model TL893 and the drives upgraded to TZ89s. This upgrade doubles the storage capacity of each library from 5.2 to 10.4 TeraBytes. We are investigating various options for the conversion of our existing datasets on the lower density DLT (compact tape III) to the higher density DLT format (compact tape IV).

Installation of the terabyte disk system has begun. The disks will be shared between the DEC OSF Alpha processors. The technology we proposed has been selected by DEC for their general offering and this hopefully will ultimately provide cluster disk sharing. A subsequent test with switched gigabit ethernet will provide throughput rates for an interim MFS sharing arrangement. RAID support for the disk array should become available in early 98.

The DLT archive jukeboxes are being upgraded to the '7000' class tape drives. This will double the storage capacity of these units as well as increase throughput.

Dipec requests have been prepared to add a slave DLT jukebox and upgrade the DEC 2100 processors to 4100 processors (2-3 times faster). The purchase orders will be submitted once funding is available.

B.3 Matchup Database (P)

We have updated web page documents for the NASA Pathfinder sea-surface temperature matchup database to reflect the release of 1996 NOAA-14 matchups and cloud detection techniques. Two manuscripts are currently in preparation which describe the details of the Pathfinder SST algorithm as applied to V4.2 GAC processing, V19 Matchup database and development of new cloud detection techniques and quality flags.

B.3.1 Historical Matchup Database

The major effort during this period was concentrated on producing a new major release of the AVHRR Pathfinder Oceans Matchups Database. The new database involves not only a longer time span (1985-1996), but also major changes in the variables included in the database. Additional satellite variables include new geometric quantities that facilitate the identification of whether a daytime matchup is on the sun side of the AVHRR scan line (and, thus, if it can be potentially affected by sun glint). Furthermore, at the request of the SST Science Working Group, the matchups now include values for all five AVHRR channels for a 5x5 pixel box centered at the matchup. This offers the possibility of using textural metrics for cloud flagging purposes. Finally, a new set of ancillary variables was added to facilitate the use of the matchups. They include an ocean basin code, bottom depth (these two allow the separation of matchups by ocean and shallow/open ocean regimes), the Reynolds interpolated SST, and an estimate of columnar water vapor derived from the SSMC/I, a microwave radiometer.

In addition to the new quantities, there was a major change in the procedures used to identify potentially cloud-contaminated matchups. In previous versions of the matchups database, we had used a series of thresholds determined by interactive exploration of the data. The new b-version of the matchups involves a new series of tests based on a technique called "classification trees." The new way of flagging clouds provides a larger number of usable matchups, while its ability to exclude cloud-contaminated matchups is similar to that of the previous procedure.

The new version of the matchup files have been completed and they are in the process of being transferred to JPL. A new version of the matchup documentation was produced and is available via the WWW.

The documentation describes methodology used to minimize sensitivity of retrieved algorithm coefficients to errors in both the satellite brightness temperatures and the in situ observations. This new capability lessens problems associated with properly identifying onset of end-of-life for the buoy measurements. The new approach utilizes a series of tests using the AVHRR spectral channels organized into a tree test as part of the cloud tests. The trees developed for each of the AVHRR instruments is presented.

Perl scripts for v19 of the archive matchup database were finalized and documented. This new version of the matchup database includes all pixel information within the satellite extraction box and additional parameters from ancillary databases. The v19 database contains all matchups, both cloud contaminated and clear extractions. Records now contain a field which identifies those pixels passing the cloud detection tests which are based on classification tree techniques developed earlier this year by Dr. G. Podesta.

Ancillary data from various sources were obtained and processed for inclusion in V19 matchup records. These additional parameters should be a valuable tools during algorithm validation and development. These sources include:

1. Daily SSMI integrated water vapor data using the recently updated Pathfinder version developed by Wentz.

2. Reynolds weekly OI sea surface temperature

3. NGDC Etopo5 water column depth

4. Weekly maximum ice masks created from SSMI daily ice data obtained from the NSIDC SSMI.

5. TOVS water vapor profiles and other parameters. The TOVS dataset received from the DAAC is 293GB, we are presently developing techniques to reformat and processing the data for inclusion in the matchup database.

We finalized the 1996 Pathfinder archive matchups database and delivered files to JPL for distribution. Coefficients and cloud detection tests for Pathfinder NO14 1996 were determined from these files. These 1996 matchups were the first full end to end V19 generation enabling the development of cloud flagging techniques using both day and night records by inclusion of tests for channel 2. This ability to include visible channel data and other ancillary parameters unique to daytime records in the decision tree process has enabled the cloud test to perform better in the daytime while still retaining nighttime performance.

B.3.2 Real-time Matchup Database

Work has focused on understanding the limitations of the real-time in situ SST data obtained by the Navy over the GTS, and development of QC procedures to flag and eliminate problem records from the database. Quality control scripts were written for both drifting and moored buoys. The drifting QC includes checks for reasonable SST values and speed and position checks. Moored buoy QC includes checks for reasonable SST values and that position remains within a 0.1 degree radius of the center of the mooring watch circle. Position re-sets due to mooring maintenance are also identified.

Both drifter and moored in situ SST values are monitored for sensor failure by comparison to a reference value. The buoy SST must be within +-10 C of the Reynolds weekly OI mean SST reference (1 degree res) . This test, however, still allows some "bad" records to pass QC due to the low time and space resolution of the Reynolds data, and the 10 C window needed to retain values in frontal areas. A second, more stringent, conformity check is presently being tested for possible use. This test uses an 18km resolution, two day, satellite SST OA analysis as the reference. In situ values within +-2 C of any reference OA located with in a 100 km radius of the in situ position are retained. Additional scripting procedures to automate the real-time extraction process were also developed. These include daily updating of orbital models, creation of extraction lists, and determination of satellite clock re-sets and drift on a real time basis.

Preliminary comparison of AVHRR SST algorithm coefficients estimated from the larger 1996 archive database with those of the 1996 real-time data stream are currently in progress.

A near real-time product will be produced using retrieval coefficients for the month obtained from the previous year. The real time in situ data is too sparse to compute stable coefficients but can be used to determine whether the historical coefficients still represent valid retrieval parameters. During the present quarter we automated and began near real-time matchup database generation for Pathfinder sea-surface temperature. This enables preliminary monthly coefficients to be estimated approximately 30 days in arrears. Presently we are evaluating the quality of coefficients estimated with this data base. Comparisons of coefficients estimated with the 1996 archive database and 1996 real-time coefficients indicates that the real-time database is severely deficient in estimating coefficients in low water vapor regimes. This problem is due to the lack of buoy data at high latitudes. We are presently attempting to identify additional high latitude buoys which may be available in real time, and experimenting with different weighting windows for coefficient estimation in low water vapor regimes to attempt to overcome this limitation.

The ability to create monthly "real time" matchups should be operational within the first quarter of 1998.

B.3.3 Ocean Color Matchup Database

We have begun obtaining in situ optical data from various sources for use in the MODIS ocean color matchup process (MOBY, VENICE TOWER, PLYMBody, BERMUDA,AERONET, SEABASS). Each data source is unique in regards to both the instruments' type and the degree to which the raw data has been reduced. We have begun developing routines to derive the needed optical parameters from the in situ radiometric data. To ensure that derived parameters are consistent across different sources a detailed understanding of the instrument response and data reduction techniques used is required. Most of the sources are providing "raw" data which will need to be correct and/or flagged for various problems such as ship-shadow, clouds, bandwidth, and atmospheric affects

before additional optical parameters are derived. For some derived parameters (e.g. nLw, K, propagation at air/sea interface etc.) different mathematical techniques/definitions are currently being employed in the scientific community. We are working to clearly define the calculation methods and to develop quality/method flags for the in situ data.

B.4 DSP Support (M)

B.4.1 Testing

We have run the MODIS Level 1 simulator to create 2 days of data to test programs with a global image.

B.4.2 Modifications/Additions to DSP

COLORSHR5F: Initial version derived from colorshr5.
ANLY6F: Initial version of David Antoine's algorithm. Derived from anly6d.
DCBIN9: Version to bin David Antoine's CZCS to 9km.
DMBIN9: Version to map David Antoine's CZCS.
INCLUDE FILES:Change syntax of define statement to work with ratf90. Declare void routines void. Fix Prologs. Change NAMSIZ from 256 to 384. Define DATA_TYPE_CHAR. Remove SUBIMAGE_SEPARATOR since it's in display.def.
MODINC/MOCEAN.H: Change NAMSIZ from 256 to 384. Add strings for hdf dimensions and attributes. Change FEXIST to do nothing and always return True. Add Mocean_GetFileID. Change Mocean_WriteImageAttr and Mocean_WriteAttr to include type as the last input parameter.
MODINC/COMMONINOUT.RAT OCEAN_LUN.F OCEAN_LUN.H OCEAN_LUN.RAT: New include files for MODIS.
MODINC/FCSLIB.H: Remove the reference to rename for vms.
MODINC/OCEAN_LUN.*: Change the lun for the Reynolds reference file from 301002 to 900030.
DIVC: New program to divide the calibrated values of one image into another.
PATHBINANG: New program to "bin" differences in brightness temps by scan angle.
MINMAXS: Specify minmax or clip using command line (instead of dsp alias so it can be run outside of dsp).
New ingest programs: PALMERREAD, TAPESCAN, TIRREAD, SCRREAD, SETORBIT, SCRVERIFY

B.4.3 Problems Fixed

ANLY8D: Correct conditional compilation for non-VMS filenames (else -> elsedef). Updated Carder chlorophyll algorithms. Declare C subroutines as void. Compute Tau_a before calling diffuse_transmittance. Return mean Tau_a to calling program. Implement latest Carder code delivery. Remove Tau_a calculation, now returned by newatm. Apply corrections to documentation records (proc_con) Remove files replaced by latest Carder delivery. Remove files superseded by wang2.f. Add latest Carder routine. Remove older routines. Remove superseded routine. Correct documentation in the headers. Update test program to match upgraded wang2.f routine. Update test script. Convert character constants.
EDGEMASK: Upgrade for new subsampling variables in satellite navigation. Add () around slope definitions just to be safe.
RATFOR: Add trailing EOS to string constants for certain screwy FORTRAN

compilers (enabled using runtime option -e).
CARTON: Correct 'buf' to 'line' for output string variable.
FRNTEDG: Encode targets required to be $DECL_STR.
GTCRCL: Encode targets required to be $DECL_STR.
PAINTR: Encode targets required to be $DECL_STR.
COLORSHR7: Must use system dependent COPTS for C compiler. Restore missing source file to library.
TRACE: Add bad value threshold option.
PATHNLC: Try to fix calibration info for tau and albedo bands. Update for newer compilers. Correct for include files being in their correct locations. Convert string constants to FORTRAN. Add Arthur's new algorithm.
PATHSST: Remove duplicate files that are already in avhrrshr5/ Update for newer compilers. Correct for include files being in their original directories. Convert string constants to FORTRAN.
AVHRRSHR5/AVHRRSUB5: Remove unused variables. Correct reference to TO(highest_channel). Remove unnecessary if statement (holdover from CZCS days.
AVHRRSHR5/RAYGETPOL: Fix code to properly ready '.new' files (was failing to handle a formatting difference between '.dat' and '.new' files).
COLORSHR/REMOVECOMMA: Declare void to remove compiler warning.
COLORSHR/CALPRINT: Correct character constants. Correct character constants.
COLORSHR8/CALAERSOL, COLORSUB8: Declare functions void to remove compiler warning.
COLORSHR8/RAYGETPOL.H: Remove nested comment.
COLORSHR5F: Change alon,alat to output arrays.
VHRR/LIB: Fix use of quotes for fortran string handling. Don't write to more than allocated size of variable SYMVAL. Adjust declaration of array to fit current usage. Fix use of characters even in commented code. Correct previous edit. Symbol not available so we redeclare its value.
SHPSPH: Fix use of quotes for fortran string handling.
GETCOM: Fix use of quotes for fortran string handling. Correct handling of character data.
INGEST PROGRAMS: Use correct character constants.
ANLY6D: Correct character constants.
CMOS, GRID, HIST, NDVI, SMOS, 2CHAN, MOSAIC9, GSFCBIN9,
CMAP9, CSBIN, 4PANEL, ANLY, MCSST, ROTATE, FILEEPS, HELPDS,
ATMCORSHR, CONVRT, ROTATE, CONTEXT,
CONTENT, SPACEBIN, ORBITSUB:
Convert string constants to FORTRAN.
MACE2: Only encode up to maximum length of output variable.
TQ2023, TQ2024: Remove C compiler warnings.
ANLY6F: New scaling for Angstrom exponent value. Small change in range checks for chlorophyll and Angstrom exponent values. Only output pixels approved by D. Antoine routine (use YFLAGS instead of LNDMSK). Use different bbaXXX calculations for unstable 4th order polynomials. Further revisions to bbaXXX fits/functions to resolve divisions by zero. Add land/shallow water bit masks.
SPACETIME: Don't wipe out band name. Allow for 9km bins (max for smallest was too small). Declare image header variables and functions to be type PTR.
MOSAIC9: Allow for input pst's which don't have associated data block describing binning characteristics - assume 9km and seam at -180.0.

ATMCORSHR: Move all include files inside subroutines.
BINSHR: Move all include files and define statements inside subroutines. Fix maketime to put leading zero in time string if seconds is less than 10. Check multiple locations if necessary to find metadata (ArchiveMetatdata.0, ProductMetadata.0, or CoreMetadata.0). Other changes to metadata stuff for V1. Straighten out use of some constants shared by the binning routines. Store input file information so we can write out file names and/or URs at the end.
DAYBOUNDS: Move include files into the module. Use ii instead of i and declare it. Add ephemeris entries to PCF file. Scripts to run program. Correct calculations for ascending data day boundary. Add calculation for descending data day boundary.
IMG2HDFBIT: Move include files into the subroutines.
MCLOUD: Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1.
MCOLSHR8: Some fixes to white cap correction stuff. Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1. Use named constants for LUNs from PCF files. Change from 8 to 9 bands. Allow interpolation grid spacing to be 1 pixel (disabled). Return additional information to main program (for debugging).
MFILL: Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1. Use named constants for LUNs from PCF files. Add more information about an error.
MMAP: Move all include files and define statements inside subroutines. Use named constants for LUNs from PCF files.
MODCOL: Move all include files and define statements inside subroutines. Some metadata changes for V1. Use named constants for LUNs from PCF files. Add SeaWiFSwhite.cal to the pcf files and fix the white cap correction stuff. Fix some fortran strings. Change some error constants in wang2.f Switch to new Ken Carder chlorophyll algorithm. New delivery from Hoge. Update headers. Remove unnecessary atmospheric parameterizations. Remove unused input variable. Convert from 8 band SeaWiFS version to 9 band MODIS version (double up 670). Update to new Gordon atmospheric routine. Correct Abbott FLH calculation. Implement Abbott CFE calculation (inc). Add/correct output products. Save current versions of PCF files. Upgrade to new Carder PAR routine. Add additional output for PAR routine. Implement new Carder clear water epsilon routine. Add threshold test value for CWEPS routine. Implement new Carder PAR and CWEPS routines. Add CVS trace variable to header. Use MODIS I/O for parameter file. Change humidity to water vapor. Add ARP/PAR calibration strings. Implement CFE calculation. Convert ARP/PAR to standard units. Initialize product variables to default failure values. Convert log10(XYZ) to XYZ in output file. Add Carder IPAR parameter file. Test neg_rrs_flag before calling carder_ipar. Test inputs before calling carder_cweps. Test inputs before computing CFE. Add new flag to FLH (invalid inputs). Convert to v2.0 Hoge algorithm. Add free_dvector to match free_dmatrx. Rearrange include files (move global declarations into subroutines and put external reference in include file). Add call to initialize various coefficients from data file (hoge_params2.dat). Disable hard coded coefficient initializations. Initial version. Move various Hoge constants out of code/include files and into data file. Add hogeio-v2.0.c linkage. Add hoge_params2.dat data

file. Update PCF template(s) for new data file. Add diagnostic output statements to verify file reading code. Use solar zenith and solar azimuth from input geolocation data. Allow single pixel interpolation grid spacing (disabling it). Add new item to PCF for Hoge. Enable optimized application build. Remove multi-line interpolation code and declarations (not used). Add additional debugging variables and output statements. Initial version of clark_params1.dat,clarkio-v1.0.c. Fill in prolog. Correct linkage name to clark_init. Add routine to update bands whose results aren't immediately available (averaged calculations). Move algorithm coefficients from code into input file for Clark. Update to current Carder algorithms.. Remove old Carder algorithm. Add module to read Clark coefficients. Update Carder algorithm file. Update PCF files for Carder, Clark & etc. changes. Add aerosol radiance output variable (for diagnostics). Add additional flags to Carder chlorophyll routine. Add aerosol radiance output to aerosol routine. Implement pixel averaging for Abbott FLH and CFE calculations. Move Clark coefficients into external data file and add routine to input them. Add diagnostic output statements. Update prologs

MODSST: Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1. Use named constants for LUNs from PCF files. Fix scaling of SST bands. Fix sst4 calculation.

MSBIN: Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1. Use named constants for LUNs from PCF files.

MSSTSHR5: Move all include files and define statements inside subroutines. Use named constants for LUNs from PCF files.

MTBIN: Move all include files and define statements inside subroutines. Straighten out use of some constants shared by the binning routines. Some metadata changes for V1. Use named constants for LUNs from PCF files.

IMG2BIT: Need max bin number large enough for 4km masks.

LOADNOHED: Remove debugs.

ATMCORSHR: Reduce interpolation grid to 1 pixel (effectively remove it).

MAPEPS2: Correct source file name. Add angstrom exponent output band.

MAPEPS5: Correct source file name.

RATF90: 'until (x)' check was reversed. generate proper translation for f90.

SSBIN-HDF: Fix type for eng_q_use. Fix use of CFLAGS. Change FOPTS. Fix dateline stuff again. Take out debugs.

VHRR: Work around f77 optimizer bug (temporary I hope).

MODCOL: Add/update trial pcf files. Rename O2_ATOT_MODx to O2_ATOT_MODnnn.

Add include file now needed for TK5.2v1 Add new variable to specify aerosol models to use. Initial version of wang3.f and parsearray.rat. Switch from wang2.f to wang3.f (and switch associated routines). update prologs Updated versions of pcf tailored to reflect changes in wang3.f and colorsub8.c. Switch to new flag arrangements in output files. Increase optimizer table limits. New output file flag definitions and layouts. Split Rayleigh table reading from Rayleigh coefficient calculation. Only check for common flags as keywords. Correct list of default keywords in pcf for mskflg. Correct defaults for mskflg. Convert to new output file flag groupings. Add support for new flags in output files. Remove arrays for unused ancillary input files. Apply optimizations: externalize 'ilo' from INTERV as it gets called with two separate angles. Remove INTERV call from SPL1D2 creating new version SPL1D2LCL and pass in index value

generated by INTERV. Create ANGLE_INDICES to consolidate code in FUNCT_EPS and TAUA_INVERT; Save results and test for same input parameters to optimize against expected repeated calls. Wrap cos() evaluations with input angle checks to optimize against expected repeat calls in FUNCT_A_B_C_D_FOURIER. Add two arguments to newatm to speed up processing. Add two arguments to newatm (current pixel and scan line). Add code to reduce calls to funct_a_b_c_d_fourier for speed. Add more debugging hooks. Correct setting of lastscan/lastpixel. Add 2-d subsampling for funct_a_b_c_d_fourier coefficients for performance. More debug printouts. Use land/sea mask from MOD35 (geoloc). Use new v2 level 1 read routines, and v2 set metadata routine. Correct Rayleigh reflectance computation. Remove oxygen correction (not used for MODIS .. already in tables). Add file access logging after each file open. Add comment terminator to silence C compiler warning. Remove land and water filenames from mice table - now using 'PGS' versions. Compute funct_eps on same sparse grid as funct_a_b_c_d_fourier. Add explicit logical for epsilon validity (was implicitly valid).

LIB/MOCEAN/MOCEANCREATE.C: Add DATA_TYPE_CHAR option. SDST change: must SWdetach and re-SWattach.

MODSST: Use new flags. Use real instead of integer constant to initialize a real variable. Change include files to work with latest toolkit. Add v2 metadata routines; change compile option limits. Add new flags and quality bands. Check both common and general flags. Use real instead of integer constants. Echo new command line properly. Change everything the user sees (input parameter names, messages) to use MODIS channel numbers. Make both sst and sst4 like pathnlc (used noaa-9 tree test for now). Add new quality and flag bands. Comment out all previously ifdef'd out code. Start to add v2 metadata routines. Change bias to be in Deg C (instead of Deg K). Add Land bit in common flags. Fix use of v2 metadata routines; use v2 L1 read routines; Fix metadata for new flag and quality bands. Read in MODIS channels 6 and 29; use new V2 level 1 read routines and metadata routines; rename all internal variables to reference actual MODIS channel numbers; use the land/sea mask from MOD03 (geoloc). Declare char parameter to be proper size array (not 1). Declare input parameter character string to be proper length (not 1); trim spaces off the end of input string. New routine setmeta to initialize metadata fields; new routine getsstpar to read run time parameters from modsst_params1.dat. New routine setmeta to initialize metadata fields; new routine getsstpar to read run time parameters from modsst_params1.dat.

MCOLSHR8: Disable old Rayleigh calculation (and reading of associated tables). update prologs Remove unused ancillary data files. Remove old Rayleigh calculation (now in wang3.f). Remove source files no longer used by library/modcol. Remove include file dependencies from makefile.

DSP: Increase the size of the hash tables.

ANLY8D: Include optimizations from MODIS version including externalizing ILO from INTERV because SPL1D2 gets called twice with different angles. So keep a separate copy of ILO for each unique call to SPL1D2 (and hence INTERV). Move constant code outside do loops in load_ss11 as the results are constant with respect to the do loops. Create two versions of agl (agl1 and agl2) to hold the results of the calculations. Only the f(x) result is used from SPL1D2 so don't compute f'(x) and f''(x).

PATHNLC: For tree test: mask1 bit 1 is brightness, bit 7 is satz; for noaa-9 check for jan 94, instead of Sep 94; add tree test for noaa-11; comment out some ifdef'd code.

PATHBIN: Increase buffer sizes to handle 4km bins. Change flags/quality determination for tree test. Comment out old code (which was ifdef'd). Change some debugs. Remove ch4m5 band from allb=2.

MODCOL: Remove unused code (previously conditionalized out). Convert printf/fprintf to sprintf/Dsp_Print. Change message output routine. Correct call to Rayleigh_IQU (missing argument). Convert print's and write's to internal-write/DspPrint. Fix to make all 4 output files look ok. Write out messages properly for MODIS, make bandnames big enough for qc file also. Use correct status message when close file successfully. Put qc bandnames in same array as other files; write metadata to all 4 files. Removed unused input from mice table: CALHDF_LUN. Fix prologs; remove prohibited functions. Use proper mcf file for dr2 file.
Fix dr2 flag band name. Add missing variable declarations (angle_indices). Use commoninout.rat instead of anly8inout.rat. Add ascending/descending metadata. Lon/lat from geoloc file is in degrees, not radians.
Fix use of ftrim. Move data statements after last declaration (forcheck problem). Change 'x' to '1x' in format statements. Fix masking to select correct bit within the mask byte (must do mod 8). Convert C style comments to ratfor style. Convert non-portable %loc() to portable iaddr(). epsflg improperly declared as real. Changed to integer. Fix parameter list for anlywto. Split long lines into multiple lines. Get rid of double ((in iaddr calls. Implement additional checks when reading Rayleigh coefficient files. Check for impending underflows and set value to zero. Correct array declaration to resemble actual usage. Trap floating point underflow values and set to finite value. Change 'g' format item to 'f10.4'.
Correct APH_CHL array dimension (6 instead of 5). Correct status check. Correct comment on array size (aph). Change 'i' format item to 'i10'. Change 'i' format to 'i15'. Use exit status of '1' for failure.
Correct size of quality flags in DR1/DR2 output files. Fix error messages. Change initialization of ILO1/ILO2 to quiet source code checker. Same result, different process. Declare get_pgs_filename function as integer. EPSMIN, EPSMAX are scalars - not arrays. Routines PGS_SMF_SetDynamicMsg
and PGS_SMF_GenerateStatusReport not used as functions. Change Automatic quality value from 'good' to 'passed'. Enable MSKBIT_VALIDATE (abort processing on global failure condition). Disable debugging code: KAI_DEBUG*. Display parameter values that were read in from the data file. Initialize 'funcname' variable for SMF/PGS toolkits. Correct constant string to have trailing NULL byte.

MODSST: Fix file close message. Add -warn_unused link option. Fix prologs; remove prohibited function. Add attributes for flag bands; pass lun for reference file instead of file name; use setsstmeta to set metadata for QC file. Fix some stuff for the qc file metadata and the QA % values. Use commoninout.rat instead of modsstinout.rat; add ascending/descending stuff. Use start/end,ascend/descend lines instead of common bit flag. Remove use of ascending flag. Fix use of ftrim. Fix encode per forcheck. Correct 16-bit constant for output array. Correct 'x' to '1x' in format statements. Convert %loc(x) to iaddr(x). Make sure iaddr and things receiving its value are declared as 'PTR'. Address forcheck complaints in source form. The compiler was happy. Convert comments from C style to Ratfor style. Fix size of L2_Flags band. Change exit status to '1'. Change 'i' and 'f' format codes to explicit field widths. Change status value check. Remove unused function declarations. Change Automatic

quality value from 'good' to 'passed'. Declare arrays to match actual usage. change setsstmeta to a function to return an error/success value. Use ftrim as a function instead of a subroutine. Declare input array to match actual usage. Use ftrim as a function. Pass proc_log to mcsstop instead of proc_con. Pass qc bandnames to set the metadata properly for the qc file. Remove old pcf files. modsst pcf file for toolkit v5.2.1.

MSBIN: Add calculation of data day bounds. Add new flag bands. Fix dateline stuff (this was actually done a long time ago). Use commoninout include file. Use ascending/descending attributes. Use new v2 MODISio and metadata routines. Get input parameters from param file instead of pcf file. Use dayboundsub to calculate the data day start and end times. Get the product quality from the input file. Use Miami version of binning data instead of SeaWiFS one pixel to one bin scheme. Use makestarttime instead of maketime to make date and time strings. Mask flags may only be the common flags, not the product specific ones. Go through sst files twice, once for ascending, and once for descending. Use 4 digits for year in all strings. (Note: this is an intermediate update because "andrew" is down and the latest source is inaccessible right now.) Change print's to encode/Dsp_Print. Fix: some flag stuff, use of ascend/descend stuff, text in proc_log. Fix prologs. Use commoninout instead of commonflags. Fix reading of orbit metadata. Move around some comments. Move some variable initializing inside the loop. Use parameter instead of constant for output LUN. New routine to get input parameters from file instead of pcf file. New routine to get the quality value for the current product. New routine to set the metadata for space binned files. Change BITS to short to be compatable with the flag variables in bit functions. Change QMSK and QBITS to be short's to be compatable with flag arrays. Change unix style comments to ratfor style. Don't declare PGS_SMF_* as functions. Fix use of subroutines vs functions. Change to function to return status. Change dataday input arrays to match actual inputs. Use PGS_SMF_* as subroutines. Use PGS_SMF_* as subroutines. Fix values for AscendingDescendingFlag.

MTBIN: Lot's of little changes to convert SeaWiFS stuff to MODIS. More changes to handle subtracting an image. (This is an intermediate check-in before I make lots more changes). Fix prologs. Add new flag bands. Use commoninout include file. Use new V2 MODISio routines. Update metadata usage for V2. Remove old code. Add new routines, gettbinpar.rat and settbinmeta.rat, to read parameter file and set metadata. Use new LUN names for input and output files. Get input parameter gsfcqual from parameter file instead of pcf file. Add new flag bands. Use 4 digits for year in all strings. Change size of opmode to contain whatever it might be in the future (instead of day or night). Update metadaa usage for V2. Comment out some ifdef'd out old code. Fix reading of orbit number from metadata. Fix dataday metadata. Write out bin model attribute. Use v2 MODISio routines. Use DayNightFlag instead of OperationMode.

MFILL: Fix prolog. Change constant name to be similar to other programs.

ATMCORSHR: Remove MODIS prolog from ratfor include file. Fix prologs. Add ascdscsub.rat set start/end, ascending/descending line numbers. Limit extreme floating point values to avoid underflow/overflow traps. Move len_str to binshr because mtbin uses it.

BINSHR: Fix prologs. Print out error messages from stripandappend. Fix constants for new number of bands (new flag bands). Use v2_meta (in MODISio) instead of the old metadata routines.

BINSHR/SETUPL3B.RAT: Fix size of flags bands.

BINSHR/MAKETIME.RAT: Merge date/time into one string. One less argument now. Fix output string.
BINSHR/STRIPANDAPPEND.RAT: Correct array declaration to resemble actual usage. Remove an extra comma.
BINSHR: Add l3in.c and l3out.rat which are now used by all of the programs which read or write time binned files.
BINSHR/L3IN.C,L3OUT.RAT: These are now used by all programs for reading and writing the time binned files, and these replace the programs individual copies of hdf-io1.rat and hdf-iom.c.
MCOLSHR8: Fix prologs.
MSSTSHR5: Disable VMS only code in error routines. Add return after stop for forcheck warning. Remove some unused variables. Correct fixed array index (was out of range). Fix prologs.
DISPLYSHR: Fix prologs.
GOELIB: Fix prologs.
IO: Fix prologs. Remove fflush for code checker. Remove reference to setcurdir.c.
MOCEAN: Fix prologs.
MODISIO: Fix prologs. Remove prohibited functions. Lots of changes in v2_meta.c, mostly for level 3 files. Remove OperationMode. Make errmsg static.
RTLIB: Fix prologs.
SATELLITE: Fix prologs.
SPHLIB: Fix up prologs. Make common block declarations more correct (navcom, navras). Add save statement for common. Correct array declaration to resemble actual usage.
ULIB: Fix prologs.
VMSFORLIB: Fix prologs.
MICE: Automatically add 'parfile=' keyword to mice table. Rename ARG_MAX (and ARG_MIN) to avoid POSIX value in system include file. Remove diagnostic print.
RATF90: Check for both single quote and double quote character strings in defines.
L22MIA: Fix calibration for lat and lon bands. Other old update changes which were never checked in. Fix output record offset.
DSP: Correct vector size mismatch between spell.c and buckets.h. Add runtime size check to catch future failures.
TIMESCR: Declare held-over values as SAVE.
PALMERREAD: Fix option parsing (use subimage separator). Don't uppercase inputs. Add EOT check for full tapes. Convert status quantities to unsigned 8 bits. Improve error checking and output messages on certain errors. Correct LUN usage with vhrio package.
SETORBIT: Add shell script for processing multiple files in one directory. Correct paths for utilities. Correct LUN usage with looksc package.
INGEST/LIB: looksc - decode open options. allow read or read/write(update) and shared.
READARCHIVE: Correct LUN usage with looksc package.
SCRREAD: Correct LUN usage with vhrio package.
SCRPACK: Correct LUN usage with vhrio package.
SCRVERIFY: Correct LUN usage with vhrio package.
TIRPACK: Correct LUN usage with vhrio package.
TIRREAD: Correct LUN usage with vhrio package.
QRMPACK: Correct LUN usage with vhrio package. Add '/SWAP' option for unusual input files.

QUORUM: Allow IFILE to be 1000 for swapped data.
PATHMAP: Changes for 3 bit quality values.
PATHFILL: Add 3 bit quality.
PATHCLOUD: 3 bit quality values.
PATHSPC: 3 bit quality values.
PATHMASK: 3 bit quality values.
PATHCOMP: 3 bit quality values.
PATHFLT: 3 bit quality values.
PATHBIN: Add allb=6, change arrays for 9km, not 4km. Change quality values to 3 bits. Add parfile keyword. Put 'in' before 'in1'. Change 2 bandnames for allb==6.
PATHTIME: Write out last partial line; use AABINS for max bin number; add some ()'s to some if statements. Change quality values to 3 bits.
PATHNLC: Change mask2, bit1 to be the 2nd sat. zenith angle threshold. Change mask2, bit2 to flag the sun side, southern hemisphere, satz>45. Reserve mask2, bit3 for ice which will be set during the level 3 processing. Add slope and bias for other temp bands (3e,4e,brights). Add allb == 6. Add 34c and change 45c to use emis. corrected value. Only call Art routine if appropriate; fix one if statement checking for allb values.
PATHBINANG: Remove land masking, fix band indexing for bright 3/4/5, fix band indexing for allb=6. Stop using band index constants in sum_structure.rat. Add scale factor for 'y' value (ch4-ch5 or ch3-ch4). Clean up makefile. Share sources/objects with pathbin.
ANLY8D: Put Carder_chlor and NDVI in last two QC slots. Add the SeaBAM chlorophyll threshold. Also add k490 constants. Get calibration modification controls. For seadas compatibility, add subsetting controls, change file naming. Check for ivmin or ivmax = 0. Replace stops with print/exit. Add calibration adjustment coefficients. Add SeaDAS hooks. Add calibration modification controls. Remove DSP specific I/O code. Change log in turbid water calc to log10 make nLw670, La765 0 in anly, not -999. overhaul the chlorophyll algorithms used and the k490 algorithm. pass calibration modification parameters in to AnlyRdI. add NDVI as a QC file dataset, for seadas compatibility, add a subsetting option and output to binary file and other minor changes. add seabam_chlor and c_chlor_v1p3 routines (in place of swf_chl-1.2.c).
COLORSHR: Limit extreme floating point values to avoid underflow/overflow traps.
COLORSHR7: Adjust WIFS path for Anc_files.
TAPESCAN: Check for too many read errors.

B.5.2 MODIS (M)

B.5.2.1 Algorithm development

Jim Brown has been integrating the latest MODIS Ocean Team science algorithms into the processing package for the Oceans SCF. He has been integrating the MODIS I/O algorithms into the processing package for the Oceans SCF. To complete this effort, valid test data files must be received to be able to verify the routines. Jim Brown has integrated Howard Gordon's latest atmospheric correction algorithms into MODIS level 1->level 2 application. He has also been optimizing these codes for execution speed while maintaining correctness of result; the optimized code is more than 15x faster than original code.

Jim Brown provided V2 software deliveries for Ocean Color (modcol) and SST (modsst) science products. These deliveries are (nearly) final versions of the at-launch science codes for both visible and infrared product algorithms. Significant optimizations have been developed and incorporated into the visible product algorithms to reduce program run times to acceptable levels.

R. Evans met with J. Brown and H. Gordon to discuss approaches to increase computational efficiency of MODCOL. It was decided to use epsilon carryover, e.g. testing a previous atmospheric correction aerosol type selection on the subsequent pixel for continued applicability. We also will reduce the frequency of the calculation of the Rayleigh-Aerosol scattering coefficients (the quartic coefficients) to a 5x5 matrix.

Howard Gordon also has been experienmting experimenting with an absorbing aerosol model using spectral matching. It is expected that the run time will at least double while the number of aerosols models could increase to 72.

Jim Brown has ported the MODIS color atmospheric correction algorithm (MODCOL) back to the SeaWiFS program to provide real timing estimates and to validate the algorithm against the SeaWiFS algorithm. Timing runs show the MODIS and SeaWiFS algorithms have comparable run times even though the MODIS algorithm contains numerous enhancements (e.g. vector vs. scalar Rayleigh, quartic vs. second order coefficients, iterative vs. direct coefficient solver). The previously instituted changes for computational efficiency have had the desired results.

B.5.2.2 Processing

In the first quarter of 1997, Richard Sikorski focused on testing and updating a VMS version of the RAL model, starting from a version originally supplied by the Rutherford Appleton Laboratory. He used the model to translate the atmospheric attenuation data into ASCII for future portability, and compared that data to published emissivities to test code and data integrity. Our data matched the published data, with our data showing better resolution.

Initially, the model produced brightness temperatures that were significantly different from expected model results. We corrected three problems:

1) Channel filters were not applied correctly to NOAA-9 channel 3, and were not applied at all to NOAA-11 channel 3. We corrected the code.

2) The set of profiles in ALBIN.2 with the VMS code was truncated. We obtained a complete version.

3) The program for reading these profiles contained a default that removed all water-vapor data from the profiles. We removed that default.

Our current VMS version of the RAL model now successfully accomplished these goals:

1) It reproduces test results that were supplied with the original model code.

2) It calculates brightness temperatures:
   Using Bramson's emissivities.
   From radiosonde profiles or supplementary SST data.
   For channels 3, 4, & 5.

For NOAA 9 and 11.
For pathlengths of 1 to 2 air-masses.

In addition to work on the RAL model code, we have been systematically reviewing radiosonde datasets, instrumentation, and data handling strategies. We have identified some shortcomings and resources worth attention.

1) Radiosondes for marine atmospheres are sparse (compared to terrestrial data). This is particularly true in the southern hemisphere.

2) Sensor behavior is problematic under some conditions. e.g. the recovery-time of the humidity sensor from saturation, and the possible effects of insolation or evaporation on the temperature sensor is not well characterized and should be studied.

3) The standard methods for reducing radiosonde data remove some of the information needed to solve sensor and advection problems. Some non-reduced radiosondes are available, and should be used to address sensor questions.

4) Other techniques, such as GPS (UCAR/JPL) and Raman LIDAR (NASA), can deliver additional data on atmospheric composition and properties, and may develop into rich sources of profile data or corrections.

We have also located additional sources of atmospheric data that can be used with the RAL model, including:

1) The NASA/Goddard Distributed Active Archive Center
The Assimilated 4-D Climate Data
The Earth Science data sets e.g. TOGA/Coare Data
The Interdisciplinary Data Collection e.g. NOAA/NASA Pathfinder/TOVS

2) The NASA/Goddard Data Assimilation Office
The GEOS-1 Multiyear Assimilation
The Upper Atmosphere Research Satellite (UARS) Data Set
TOGA COARE Assimilations

3) The NASA/Langley Distributed Active Archive Center
The Liquid Water (lwp) data set
The Cloud Liquid Water (lwpcld) data set
The Water Vapor (pwc) data set

4) The NASA/Marshall Distributed Active Archive Center
The NASA Water Vapor Project (NVAP) Data Set

5) The NCAR Atmospheric Technology Division Research Data Program
The Tropical Ocean/Global Atmosphere (TOGA-COARE) data set

6) The NOAA Forecast Systems Laboratory (FSL) National RAOB database

7) The TIGR Radiosonde database

8) The University of Colorado
The Arctic Water Vapor Characteristics Data Set
The TOVS Pathfinder Path-P Arctic Atmospheric Data

Bob Evans and Pete Evans worked with Dennis Clark of NOAA/NESDIS to improve the networking at Hawai MOBY site. Optical fiber, network hardware and IR LAN hardware were installed.

Timing for space bin (SBIN) suggests that further efficiencies might be possible. Present timings for SBIN are equivalent to MODCOL and represent 2/3 user (program) and 1/3 system time.

MOCEAN PGE timings were supplied to Wayne Esaias for presentation to the resource panel. Present timings suggest (from actual runs using SeaWiFS data run on a R10k challenge with 7 concurrent PGE executions under control of Autosys) that 11 processors are needed with the followng breakdown:

L-2:
MODCOL - 4.0
MODSST - 1.0

L-3:
SBIN color - 4.0
SBIN sst - 0.5

TBIN color - 1.4
TBIN sst - 0.2

Total Processors:
approximately 11 dedicated continuously for 24 hours.

B.5.2.3 MODIS Documentation

All prologs for subroutines in the MODIS oceans software were updated to reflect version 2, in compliance with NASA software development standards and guidelines. The file format description document was also updated with new file descriptions and obsolete description deleted where required. Volume and loads documents were updated to reflect the addition of new flags in V2.

We have updated prologs and file format descriptions for version 2 Time and Space binning modules of the MODIS oceans processing code.

In conjunction with Dr. Mark Abbott and Jasime Bartlett of the University of Oregon Corvalis, an outline was developed for an overview document of the MODIS software. This overview will describe each of the MODIS oceans software modules and their associated subroutines and algorithms. We have completed the MODIS/GLI document which describes the structure, components and implementation of the MODIS ocean color and sea-surface temperature processing codes. This document should be made available the general community in early 1998.

B.5.2.4 Mod_sst coefficients

Preliminary coefficients for the MODIS V2 SST algorithm were estimated using a simulated SST matchup database. The simulated matchups were developed by Drs. P. Minnet and R. Sikorski using radiosonde data as input to a modified Rutherford-Appleton Laboratory radiative transfer model which estimated both sea-surface temperature and satellite brightness temperatures at MODIS wavebands.

B.6 Team Interactions

Attended Spring MODIS team meeting.

Attended MOCEAN team meeting.

We prepared MOCEAN network requirements for Miami; these results were sent to Sol Broder and Wayne Esaias.

Attended EAP meeting, reported to Masuoka and Esaias.

Discussed with Wayne Esaias the plans to phase product delivery, the "ramp up" at the DAAC, the test data for initial code test and the DAAC delivery.

Attended a demonstration of a web based method to select data fields and areas of interest (potential adjunct to data delivery). Met with R. Smith, who presented data obtained from the Antarctic LTER experiment, and will provide point station data from LTER grid and associated AVHRR/LAC passes to assist with checking high latitude SST retrievals.

R. Evans attended October MODIS team meeting.

A meeting attended by SDST, Hughes and Miami representatives was held at SDST in February to discuss options for reducing the number of MODIS ocean ESDTs.

R. Evans attended the SeaWiFS calibration meeting (C. McClain).

MOCEAN PGE timings were supplied to Wayne Esaias for presentation to the resource panel.

In November we hosted a visit by B. Serafino and R. Buzby of the UCAR/NCAR supercomputing facility. We shared experiences of using DEC and SGI multi-processor machines as alternatives to traditional supercomputers; they offered their experiences concerning SGI and HP.

In conjunction with Dr. Mark Abbott and Jasime Bartlett of the University of Oregon Corvalis, an outline was developed for an overview document of the MODIS software.

C. FUTURE ACTIVITIES

C.1 Automatic Processing Database Future Work (P)

a. Continue algorithm tests and Pathfinder-Reynolds comparisons.

b. Analyze sst anomalies (Pathfinder-Reynold's) for correlations with other fields, such as SSM/I water vapor and TOMS aerosols.

c. Production of the 9 km global and 4 km coastal product will alternate for a given year as we compute backwards in time to produce the complete AVHRR time series using the verison 4.2 pathfinder algorithms.

d. Using AVHRR brightness temperatures and the Reynold's OI analyzed sst, a series of tables will be generated to test non-linear behaviour of coefficients for increments of latitude and time. The table will be populated as a function of channel difference vs. satellite zenith angle. The final tables will be assembled in increments of 10deg latitude and quarterly in time.

e. We will check how the 3.7-11um test affects/limits daytime retrievals in the 1996 retrospective matchups.

f. A near real-time product will be produced using retrieval coefficients for the month obtained from the previous year.

C.2 Processing Systems Future Work (M)

a. An additional OC12 connection will replace the current OC3 link to the campus switch in the next quarter.

b. Continue testing of Gordon's algorithms and its interaction with HDF ancillary routines.

c. Continue timing tests with CZCS and SeaWiFS algorithms.

d. Complete installation of the terabyte disk system. RAID support for the disk array should become available in early 98.

e. Complete the upgrade of the DLT archive jukeboxes to the '7000' class tape drives.

f. Add a slave DLT jukebox and upgrade the DEC 2100 processors to 4100 processors.

C.3 Matchup Database Future Work (P)

a. Complete two manuscripts which describe the details of the Pathfinder SST algorithm as applied to V4.2 GAC processing, V19 Matchup database and development of new cloud detection techniques and quality flags.

b. Complete a preliminary comparison of AVHRR SST algorithm coefficients estimated from the larger 1996 archive database with those of the 1996 real-time data stream.

c. Continue to collect in situ optical data from various sources for use in the MODIS ocean color matchup process. Developing routine to derive the needed optical parameters from the in situ radiometric data. Work to clearly define the calculation methods and to develop quality/method flags for the in situ data.

d. Continue to develop real-time retrieval coefficients for the month obtained from the previous year. The ability to create monthly "real time" matchups should be operational within the first quarter of 1998.

C.4 DSP Future Work (P)

a. Continue testing of processing methodology.

b. Continue to expand the number of sites and platforms supported.

C.5 MODIS (M)

a. Delivery of prototype ocean code to MODIS team.

b. Continue with development of V2 code, implement PSA, work with SDST to determine how PSA and other searchable metadata can be utilized in production rules.

c. Work with team to update product algorithms.

d. Gather and exchange input/output requirements between ocean team members to achieve consistency in data flow.

e. Work with Hughes on processing rules/scenarios.

f. Work with SDST to determine how production rules will be implemented for ocean processing.

g. Meaningful testing of level 3 processing will require at least several days of data. We are currently generating one week of synthetic MODIS data for this purpose. The resources required to generate and archive this dataset are significant, and it will not be available until after the scheduled delivery of the level 3 PGES. We will begin stress testing of level 3 PGES after the scheduled January 1998 code submission and provide updates as necessary.

C.6 Future Team Interactions

None listed seperately.

D. Problems Encountered

D.1 Automatic Processing Database Problems (P)

a. Equipment problems limited processing in November, and software problems required re-running much of what had previously been processed. Specifically, PFV42 (Pathfinder version 4.2) was processed for 1996, however, an error in the cloud masking method (which was using the new 3-bit quality incorrectly) made the output quality incorrect.

b. A second run of 96 was begun, but slowed by equipment problems during last quarter of 1997. Also, an orbit was identified that had anomalies in the sst homogeneity test.

D.2 Processing Systems Problems (M)

a. A number of minor problems were discovered and corrected in the the PATHTIME program (which combines two or more binned data files).

b. A new method of making the archive tapes for transferring the PFV4 files to JPL was not successful, so we returned to cloning of the archive tapes.

c. The calculations of tau-1 (which has occasionally been used as a diagnostic filed) were found to contain errors and were subsequently corrected.

d. A corrupted weekly file was identified in week 9224, and it was discovered that a number of files in the DLT archive had not backed up correctly. The corrupted files were replaced.

e. It was discovered that the most recent tree method of pixel selection was not used for the PFV4 (Pathfinder 4.0) version. Some other changes were also made, and the entire set was recalculated; this run was termed PFV41 (Pathfinder version 4.1). Omission of the flag test primarily affected how each pixel was flagged, and not the value of the SST calculation itself.

f. Due to the restructuring of Level 3 files, the number of ESDTs required for Oceans processing increased dramatically. A meeting attended by SDST, Hughes and Miami representatives was held at SDST in February to discuss options for reducing the number of MODIS ocean ESDTs. Hughes has recommended the use of one ESDT per parameter per level.

g. A disk crash destroyed the Sybase database on the machine "andrew". We were successful in restoring AutoSys client functions, but until a new disk is located we are without the "andrew" AutoSys console.

D.3 Matchup Database Problems (P)

a. Comparisons of coefficients estimated with the 1996 archive database and 1996 real-time coefficients indicates that the real-time database is severely deficient in estimating coefficients in low water vapor regimes. This problem is due to the lack of buoy data at high latitudes.

b. The quality control of the Navy real-time observations is a concern. For example, retrieval dates for a given day span from a week in the past to a week in the future. Retrieval dates and locations must be tested.

D.4 DSP Related Problems (M)

None listed separately (see Section **B.4.3).**

D.5 MODIS Related Problems (M)

a. Channel filters were not applied correctly to NOAA-9 channel 3, and were not applied at all to NOAA-11 channel 3. We corrected the code.

b. The set of profiles in ALBIN.2 with the VMS code was truncated. We obtained a complete version.

c. The program for reading these profiles contained a default that removed all water-vapor data from the profiles. We removed that default.

d. Radiosondes for marine atmospheres are sparse and sensor behavior is problematic under some conditions, and the possible effects of insolation or evaporation on the temperature sensor is not well characterized and should be studied.

e. The standard methods for reducing radiosonde data remove some of the information needed to solve sensor and advection problems.

D.6 Team Interaction Problems

None.